Canada in a Changing Climate: Health Impacts
Research and Implications for Successful Adaptation

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Land & Ocean Temperature Percentiles Jan–Nov 2014
NOAA's National Climatic Data Center
Data Source: GHCN–M version 3.2.2 & ERSST version 3b

- Record Coldest
- Much Cooler than Average
- Cooler than Average
- Near Average
- Warmer than Average
- Much Warmer than Average
- Record Warmest
Regional key risks (IPCC Synthesis Report 2014)

Polar Regions (Arctic and Antarctic)

- Risks for ecosystems
- Risks for health and well-being
- Unprecedented challenges, especially from rate of change

North America

- Increased damages from wildfires
- Heat-related human mortality
- Increased damages from river and coastal urban floods

Representative key risks for each region for

**Physical Systems**
- Glaciers, snow, ice and/or permafrost
- Rivers, lakes, floods and/or drought
- Coastal erosion and/or sea level effects

**Biological Systems**
- Terrestrial ecosystems
- Wildfire
- Marine ecosystems

**Human & Managed Systems**
- Food production
- Livelihoods, health and/or economics
Major Categories of Health Impacts

- Injuries, disease and deaths due to more intense heat waves and fires
  - Very High Confidence
- Under-nutrition resulting from diminished food production
  - High Confidence
- Food and water-borne diseases
  - Very High Confidence
- Vector-borne diseases
  - Medium Confidence
- Modest improvements in cold-related mortality and morbidity in some areas
  - Low Confidence

IPCC, 2014
A Call to Action for Health

“Climate change...the defining issue for public health during this century”

Dr. Margaret Chan, Director General, WHO, 2007

But Also – American Public Health Association (2010), Lancet Commission (2010), and US Environmental Protection Agency (2013)
Assessment Update 2014

Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation

- Update to the 2008 report *From Impacts to Adaptation: Canada in a Changing Climate*
- Assesses literature published since 2007 on climate change impacts, adaptation and vulnerability in Canada
- Includes chapters on natural resources, food production, industry, biodiversity and protected areas, **human health**, and water and transportation infrastructure.
- Targets decision-makers from government, business and industry, science and policy advisors and university level instructors and students

http://www.nrcan.gc.ca/environment/impacts-adaptation/assessments/10029
Assessment Update
2014: Key Findings
Canada’s Changing Climate

Canada’s changing climate affects pathways through which impacts on the health of Canadians and the health sector occur.

Decreasing sea ice extent

Amount of warming varies across Canada

Warming trend of 1.5°C
There is stronger evidence of the wide range of health risks to Canadians posed by a changing climate.
Health Risks from Impacts on Air Quality

Ambient Air

Climate change will increase health risks from poor air quality (e.g., O₃, PM, alleroallergens)

Between 1995 and 2009, the length of the ragweed season increased by 27 days in Saskatoon and 25 days in Winnipeg

Kelly et al., 2012
# Health Risks from Impacts on Air Quality

<table>
<thead>
<tr>
<th>Air Contaminants</th>
<th>Climate Change and Related Drivers</th>
<th>Health Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground-level ozone</td>
<td>Increased temperatures</td>
<td>• Premature mortality</td>
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<td></td>
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<td>• Respiratory symptoms, inflammation</td>
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<td>• Impacts on immunological defences</td>
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<td></td>
<td></td>
<td>• Cardiac effects</td>
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<td></td>
<td></td>
<td>• Adverse long-term respiratory impacts</td>
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<td>Particulate matter - coarse (PM$<em>{10}$), fine (PM$</em>{2.5}$) and ultrafine (PM$_{0.1}$)</td>
<td>Wildfires, Drought, Renovations to weatherize buildings</td>
<td>• Mortality</td>
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<td></td>
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<td>• Cardiac outcomes</td>
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<td></td>
<td></td>
<td>• Lung cancer mortality</td>
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<td></td>
<td></td>
<td>• Restricted activity days</td>
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<td></td>
<td></td>
<td>• Respiratory symptoms</td>
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<tr>
<td></td>
<td></td>
<td>• Bronchitis</td>
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<td></td>
<td></td>
<td>• Asthma exacerbation</td>
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<td>Aeroallergens (e.g., from trees, grasses, weeds, molds, dustmites)</td>
<td>Warmer temperatures</td>
<td>• Allergic responses in sensitized individuals</td>
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<tr>
<td></td>
<td></td>
<td>• Exacerbation of respiratory diseases (e.g., asthma and chronic obstructive pulmonary disease)</td>
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<tr>
<td>Fungi (e.g., and infectious bacteria)</td>
<td>Moisture in buildings from infiltration of rain or flooding, Poorly designed ventilation and air-conditioning systems, Poor building maintenance, Warmer and drier summers in western Canada</td>
<td>• Respiratory disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cryptococcal disease (cryptococcosis) which can result in pneumonia or meningitis</td>
</tr>
<tr>
<td>Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs)</td>
<td>Dampness in buildings</td>
<td>• Asthma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Allergies</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>Use of portable gas-powered or electric generators, oil and gas furnaces, fireplaces, or candles during weather-related emergencies</td>
<td>• Fire-related injuries and death</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CO poisoning</td>
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</tbody>
</table>
Food and Water Quality at Risk

• Greater confidence of link between cases of salmonellosis and higher temperatures and between acute gastrointestinal illness and both high and very low precipitation levels.

• Limited information on climate change impacts on food security and health in southern Canada but significant concern in northern Canada.

• Climate change could affect pathways by which chemical contamination occurs in water bodies (e.g., pesticides, nutrients, POPs) through flooding, storms and precipitation.
Emergence of Lyme risk in the Canadian environment is underway - the annual incidence of Lyme disease has increased from approximately 30 cases a year to over 250 in recent years.

Lyme vector is spreading into Canada at a rate of 35-55km per year.
Risks from Lyme Disease will Continue to Grow

Ogden et al., 2008
A range of climate-related natural hazards continue to impact communities, presenting increasing risks to health in the future.
Hurricane Katrina - 800,000 Americans Displaced

Katrina Diaspora

Increased Frequency and Severity of Natural Hazards

• Climate change can result in “unprecedented” extreme events with severe impacts on individuals and communities

• Limited surveillance of health impacts from extreme weather events in Canada – national level data are sparse

• Storms can affect health through the disruption of medical care and other social services
Extreme Heat in Canadian Communities

The diagram illustrates the number of hot days and warm nights above specific temperature thresholds for various Canadian cities from 1961-2000, 2011-2040, 2041-2070, and 2071-2100.

- **Winnipeg**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Windsor**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Hamilton**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Toronto**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Kingston**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Montréal**:
  - Hot days: 20-30
  - Warm nights: 10-20

- **Fredericton**:
  - Hot days: 20-30
  - Warm nights: 10-20

The data suggests an increase in the number of hot days and warm nights in all cities across different time periods.
Drought Impacts on Health

- Droughts can lead to lower groundwater levels and stream flows, increase wind erosion of soils, and cause cracking of cisterns and cracked septic tanks – and therefore increase in water borne pathogens and water contamination leading to gastroenteritis.

- Droughts can facilitate spread of certain vector-borne diseases and lead to suboptimal nutrition due to food shortages, lack of food availability, and high costs.

- Droughts can also increase stress and mental health issues.
Brazil Drought 2015

- People stockpiling water in apartments, drilling wells and other emergency measures
- Large hospitals installing in-house water treatment and recycling centers to be able to carry out surgeries and other services
- Dengue fever cases in Sao Paulo have tripled with people collecting rainwater in open buckets

Psychosocial Impacts of Climate Change

Berry et al., 2009
Provincial, territorial and local health authorities are gaining more knowledge of climate change and health vulnerabilities through assessments and targeted research.
### Urban and Rural Vulnerability to Health Impacts

<table>
<thead>
<tr>
<th>Key Vulnerability Factors</th>
<th>Examples of Urban Characteristics</th>
<th>Examples of Rural Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exposure</strong></td>
<td>• Complex infrastructure, high density buildings and landscape dominated by impervious surfaces</td>
<td>• Increased health risks from water contamination due to a high reliance on small drinking water systems</td>
</tr>
<tr>
<td>• Geography</td>
<td>• Higher population density</td>
<td>• More people employed in outdoor occupations</td>
</tr>
<tr>
<td>• Land use</td>
<td>• Higher air pollutant levels</td>
<td>• Higher risk of exposure to land-shifts, wildfires, vector borne diseases and floods</td>
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<tr>
<td>• Climate</td>
<td></td>
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<tr>
<td><strong>Individual Sensitivity</strong></td>
<td>• Ageing population</td>
<td>• High elderly population and high incidence of chronic illnesses, smoking and obesity</td>
</tr>
<tr>
<td>• Age and Gender</td>
<td>• Cardiovascular and respiratory conditions in large urban centers from air pollution and extreme heat</td>
<td></td>
</tr>
<tr>
<td>• Health status</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Key Adaptive Capacity Factors</strong></td>
<td>• Greater prevalence of high risk population groups, with limited adaptive capacity (e.g. low socio-economic status)</td>
<td>• Limited access to services during extreme events (e.g. power, water, food, medical)</td>
</tr>
<tr>
<td>• Socio-economic status</td>
<td>• Higher prevalence of social isolation and limited access to services (e.g. immigrants, First Nations, homeless or persons of low income or with mental illnesses)</td>
<td>• Limited availability and accessibility of public services and programs and communication venues to deliver health and emergency messages</td>
</tr>
<tr>
<td>• Public services and risk communication programs</td>
<td>• High reliance on critical infrastructure for health care and emergency service provision that are vulnerable to extreme weather</td>
<td>• High dependency on natural resources that are vulnerable to disruption from extreme weather</td>
</tr>
<tr>
<td>• Employment</td>
<td></td>
<td>• Lower proportion of population highly educated</td>
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<tr>
<td></td>
<td></td>
<td>• Limited livelihood and economic diversification</td>
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<tr>
<td></td>
<td></td>
<td>• Limited resources and services to respond to extreme weather events and associated health burdens</td>
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<tr>
<td></td>
<td></td>
<td>• Limited service access in remote communities</td>
</tr>
</tbody>
</table>

**TABLE 6**: Urban and rural characteristics that increase vulnerability to climate change and climate-related impacts.
Adaptation tools and measures, such as heat alert and response systems, projections of vector-borne disease expansion and greening urban environments can help protect Canadians from the effects of climate change being felt now and those from future impacts.
Innovative Adaptations

Vulnerability assessments of high risk populations

Actions to address secondary health impacts

Use of new adaptation technologies

Increasing resiliency of health facilities

Preventative adaptation measures

Advice to health care providers

New Health Adaptations
New Tools for Adaptation

Figure 9: Vulnerability to heat in Toronto (Source: Toronto Public Health, 2011a).
New Adaptation Technologies

Smart Windows


Green Walls

http://www.modernhippiemag.com/tag/green-walls
State of Health Adaptation in Canada

Adaptation can contribute to the wellbeing of current and future populations, the security of assets and the maintenance of ecosystem services now and in the future as the climate changes.

- Relative to other countries Canada is making progress on health adaptation.
- Canadian expertise on climate change and health issues is growing and many universities and organizations are undertaking research in this area.
- Few health authorities at regional and local levels have conducted full climate change and health vulnerability assessments.
- Has been increase in number of provinces and territories that have included climate change and health information and considerations in their climate change plans.